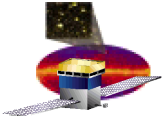


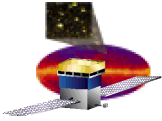
GLAST Large Area Telescope Science Program & Collaboration Organization

Peter F. Michelson
Stanford University



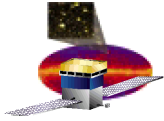
Introduction

- Hardware responsibilities are clear: organization chart for management of hardware / flight software follows from recognition of these responsibilities
- Collaboration science program organized around key science themes and 3 key projects
 - Need to clarify scientific roles and responsibilities of co-investigators, associate scientists, graduate students, post-docs;
 - Need collaboration publication policy (technical and scientific);
 - Need policy for how new collaboration members are added



Collaboration Science Program

- Science Program specified in flight proposal response to AO – proposal is for science investigation, not just for instrument
- GLAST is a facility to be utilized by the scientific community – Guest Observer program a vital part of GLAST mission
- NASA AO specifies data policy; mostly consistent with data policy recommended by GLAST Facility Science Definition Team
 - Team responsible for 1st year all-sky survey;
 - Transients released “immediately”;
 - Team could propose for specific sources (exclusive rights to data on broad classes of sources not allowed), and we did;
 - Team can propose observations for subsequent years as part of GLAST Guest Observer program (similar to CGRO);
 - Team is responsible for Instrument Operations; overlap with GLAST Science Center and Mission Ops to be clarified during Formulation Phase



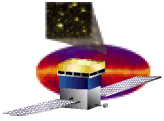
Key Science Themes

GLAST LAT Strengths

Science Themes

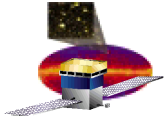
NASA OSS Goals

✓	✓	✓		✓	Particle Acceleration in AGNs, Pulsars & SNRs		✓		✓
✓		✓		✓	Resolve the γ -ray sky		✓		✓
	✓		✓		High-energy behavior of GRBs and transients	✓	✓		
✓	✓	✓	✓	✓	Galactic dark matter and the early universe	✓		✓	
Large FOV (2.4 sr) with calorimetry & low bkgnd.					Formation of structure in the early universe				
Energy range to < 10% spectral res.					Extreme Environments				
Fine angular resolution (0.39° @ 1 GeV)					Nature of dark matter				
Low instrument resolution (20 μ s)					Exchange of energy & matter between stars & ISM				
Bkgnd. Rejection $2.5 \times 10^5:1$ with high γ efficiency									



GLAST LAT Science Team Key Projects

- All-Sky Survey: Catalog
- Gamma-ray Bursts & Transients: GRB Catalog and On-line alert
- In-depth Analysis of Selected Sources



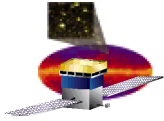
Data Products from LAT Team Projects

Table 2.1.4: All-Sky Survey Project

Data Product	Updates	Comments
Source Catalog	Available and regularly updated on the web, with major publications after 1, 2, and 5 years	Includes significance, flux, spectra, locations, and identifications
All-Sky Map	1, 2, and 5 years	Intensity, counts, and exposure maps over various energy ranges
Residual Maps	1, 2, and 5 years	A residual map for each all-sky map after subtracting point sources and Galactic emission
Diffuse Model	Prelaunch, then update as necessary	

Table 2.1.5: GRB and Transients Project

Data Product	Updates	Comments
GRB Catalog	Monthly via WWW, with periodic refereed publications	Includes fluence, durations, time profiles, spectra, and locations
Transient Alerts	Continuous, on a timescale of days via WWW and IAU circulars for transients. Continuous, on a timescale of seconds for GRBs and via GCN.	GRBs and other transient alerts will include flux and locations. Flaring sources will include possible identifications



In-depth Analyses of Selected Sources

Table 2.1.6: Selected Sources for In-depth Analyses

Sources	Characteristics	Science Goals
PARTICLE ACCELERATION in PULSARS and PLERIONS		
PSR 1951+32	EGRET pulsar, 39.5 ms, 100 kyr, 2.5 kpc, $B=10^{12}$ G,	Study phase-resolved spectra and test LAT absolute timing data and software; measure the cut-off energy E_{cut} above 10 GeV to extend the $E_{\text{cut}}(B)$ relation; spatially resolve its remnant CTB80 ($\phi=80^\circ$)
PSR 1617-5055	Radio pulsar not seen by EGRET despite its 8 th rank in E/D^2 , 69 ms, 8 kyr, 6.5 kpc	Deeply search for pulsed emission to constrain the beaming fraction in γ rays vs. polar cap and outer gap predictions; search for DC emission from its remnant RCW103 ($\phi=10^\circ$)
PSR1853+01 plerion	267 ms, 20 kyr, 3.3 kpc, $B=2 \times 10^{13}$ G, high E/D^2 , in 3EG1856+0114 error box	Study DC emission from the X-ray/radio plerion; search for pulsed emission to extend the $E_{\text{cut}}(B)$ relation to high field; spatially resolve the outer shell ($\Omega 44: \phi \sim 30^\circ$)
COSMIC-RAY ACCELERATION in SUPERNOVA REMNANTS		
Cas A	SN II in ~ 1670 , 2.8 kpc, $\phi=5^\circ$	Study young shocks in SN II and SN Ib environments: radio to TeV data to separate electron and nuclei emission; long-term monitoring to look for a compact star; higher density for Cas A & increased LAT sensitivity at $b=6.8^\circ$ for Kepler
Kepler	SN Ib in 1604, 4.4 kpc, $\phi=3^\circ$	
Cygnus Loop	Sedov phase, 360 pc, $230^\circ \times 160^\circ$	Later SNR stage: spatially and spectrally resolve the nuclei emission; study non-linear acceleration; low Galactic background ($b=8.5^\circ$) for Cyg Loop; enhanced nuclei emissivity expected where IC443 overtakes an H_2 cloud and X-ray and radio spectra harden
IC443	Sedov phase, 1-2 kpc, $\phi=45^\circ$, in 3EG 0617+2238 error box	
RX0852.0-4622 "Vela, Jr."	680 yr, $\phi=2.1^\circ$, closest SNR to Earth, 4.4° away from intense Vela pulsar	Observe using photons from Vela off-pulse time intervals to test source searches and localization in the wings of intense neighbors
NEARBY GALAXIES		
M31	670 kpc, $\phi \sim 3^\circ$	Spatially and spectrally resolve their interstellar γ radiation to study cosmic rays, magnetic fields; compare energy balance and mass tracers in different metallicity environments
LMC	55 kpc, $\phi \sim 8^\circ$	
SMC	63 kpc, $\phi \sim 3^\circ$	
A 1656 Coma cluster	$z=0.02$, $\phi \sim 1^\circ$	Constrain the energy density of cosmic rays inside a cluster; resolve the predicted emission above a low background ($b=89^\circ$); study the merging of two clusters
ACTIVE GALACTIC NUCLEI		
PKS0528+134	EGRET flat spectrum quasar, $z=2.06$	Multi-wavelength, multiyear monitoring to explore particle acceleration in blazar jets, in particular γ -ray spectral evolution from quiescent to flaring states
Mrk 501	TeV BL Lac, $z=0.03$	
Cen A	Radio galaxy, $z=0.002$, 3EG1324-4314	Confirm EGRET detection and study γ -ray emission from AGN jets at large viewing angles ($>70^\circ$)
UNIDENTIFIED SOURCE REGIONS		
Rabbit region: $l=313^\circ \pm 1^\circ$, $b=0^\circ \pm 1^\circ$, Ω region: $l=17.5^\circ \pm 1.6^\circ$, $b=-0.75^\circ \pm 0.75^\circ$	3EG1420-6038 and 3EG1410-6147	Identify the γ -ray sources in complex regions and test source confusion limits: Rabbit: 2 SNRs, 1 candidate pulsar, 1 candidate plerion, and a few non-thermal shells Ω : 2 SNRs, PSR1823-13 (high E/D^2), and PSR1822-14
Galactic Center	$l=0^\circ \pm 1^\circ$, $b=0^\circ \pm 1^\circ$, 3EG1746-285	
3EG1835+59	Brightest high-latitude, unidentified source, $E^{-1.7}$ spectrum	Search for a radio-quiet pulsar, test periodicity search software
GALACTIC SOURCES WITH RELATIVISTIC JETS		
GRS1915+105	Micro-quasar, 12.5 kpc, jet velocity = 0.9.c	Search for predicted γ -ray emission from relativistic jets at large angles and compare to AGN emission; multi-year monitoring for flaring activity
SS433	5 kpc, jet velocity = 0.3.c	

Sources selected to:

- initiate team's science program;
- best evaluate instrument performance;
- improve all aspects of LAT data analysis & software, benefiting entire community

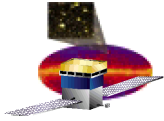
Analysis will:

- use all-sky survey data and multiwavelength campaigns where applicable;
- take advantage of team's expertise, particularly in modelling the structured Galactic background to resolve extended sources

Collaboration Organizational Issues

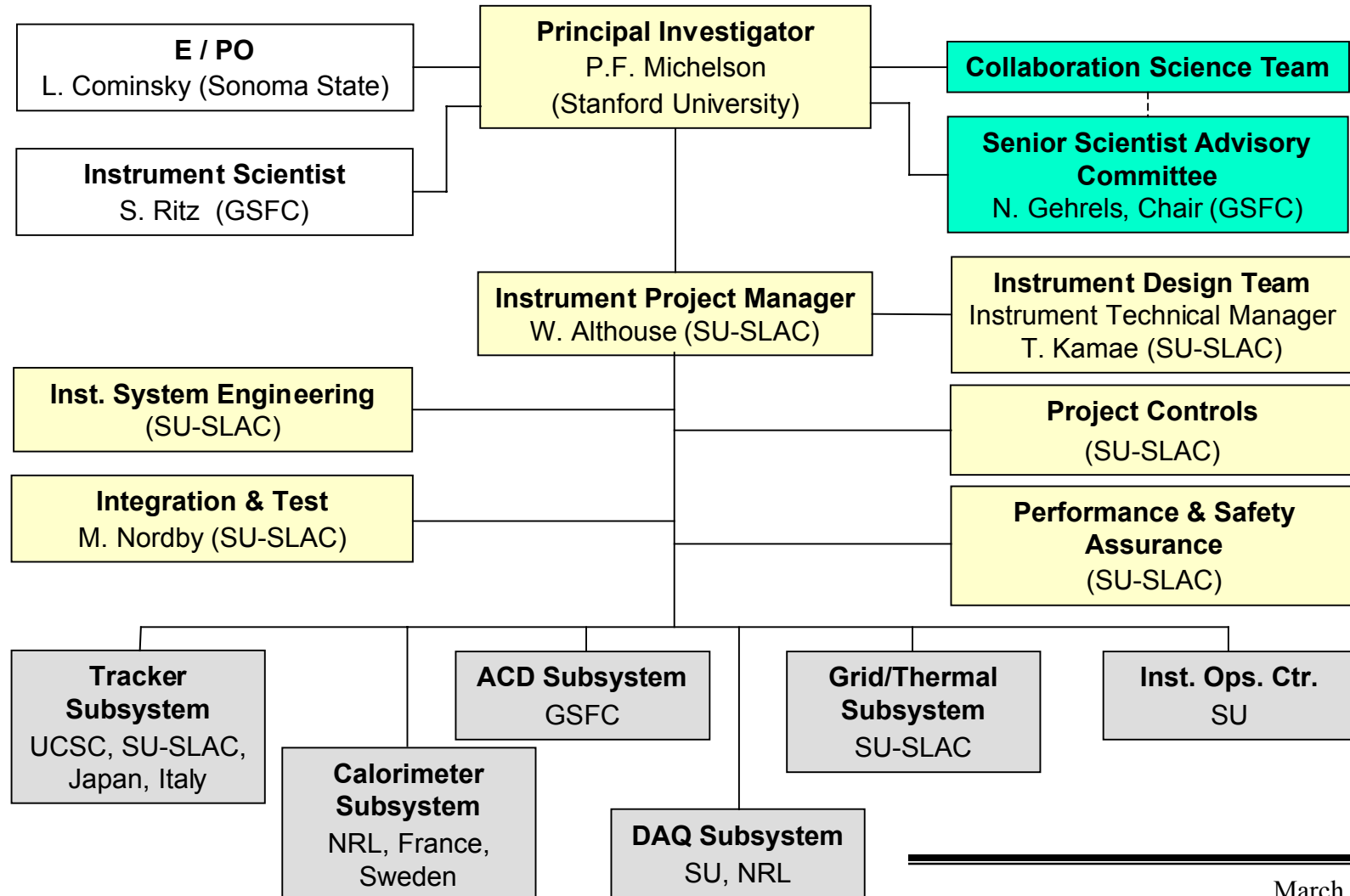
Who says we're not organized?

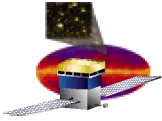




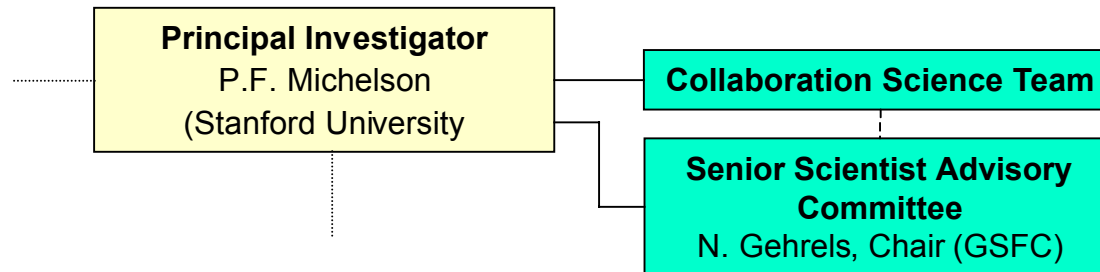
GLAST LAT Organization Chart

- Organization Chart reflects institutional responsibilities for hardware, software, instrument management, science investigation

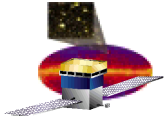




Collaboration Science Team Organization



- Current **Collaboration Science Team** consists of Co-Investigators and Associate Scientists named in flight proposal: 41 Co-Investigators, 34 Associate Scientists
- **Data Responsibilities (and Rights) and Team's Key Projects** established by the GLAST Facility Science Definition Team, AO 99-OSS-03, and the accepted Flight Investigation proposal
- **Senior Scientist Advisory Committee (SSAC):** advisory to Principal Investigator on scientific matters and will assist/advise in the scientific organization of the collaboration. Membership consists of sub-group of co-investigators named in proposal

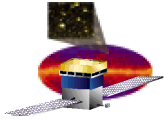


Co-Investigators

Prof. Isabelle Grenier Dr. Philippe Goret Dr. Jacques Paul Dr. Arache Djannati-Atai	CEA-Saclay IN2P3 (College de France) IN2P3 (Ecole Polytechnique) IN2P3 (Bordeaux)	Dr. Eric Grove Dr. W. Neil Johnson Dr. Michael Lovellette Dr. Kent S. Wood Dr. Bernard F. Philips	NRL NRL/George Mason U. SU-HEPL
Dr. Patrick Fleury Dr. Thierry Reposeur	 GSFC	Dr. Ying-Chi Lin Dr. Patrick L. Nolan Dr. Scott D. Williams Dr. P. Roger Williamson Prof. Elliott D. Bloom Dr. Richard Dubois Dr. Gary L. Godfrey Prof. Tuneyoshi Kamae Dr. James J. Russell	 SU-SLAC
Dr. Neil Gehrels Dr. Alexander A. Moiseev Dr. Jay Norris Dr. Jonathan F. Ormes Dr. Steven Ritz Dr. David J. Thompson Dr. Seth W. Digel Prof. Takashi Ohsugi Dr. Patrizia Caraveo Dr. Aldo Morselli Prof. Guido Barbiellini Dr. Tadayuki Takahashi Prof. Per Carlson	 GSFC/USRA Hiroshima U. IFC, CNR INFN (Roma II) INFN (Trieste) ISAS KTH-Stockholm	Dr. Roland Svensson Prof. Lynn R. Cominsky Dr. Daniel J. Suson Prof. Tadashi Kifune Prof. Robert Johnson Prof. Hartmut Sadrozinski Prof. Terry Schalk Prof. Thompson H. Burnett	Stockholm Obs. Sonoma State U. Texas A&M U. UCRR, U. Tokyo UCSC U. of Washington

Co-Investigators:

- named in flight proposal and confirmed by NASA Associate Administrator upon acceptance of proposal,
- have identified hardware or software responsibility or identified organizational responsibility for some key aspect of proposed science program,
- major time commitment implied ($\sim 50\%$)

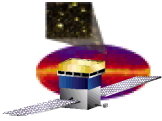


Associate Scientists

Associate Scientists:

- named in flight proposal; additional Assoc. Sci. can be added with advice of SSAC;
- if at Co-I institution, participation in science analysis negotiated with lead Co-I and PI; otherwise negotiated with PI on advice of SSAC;
- time commitment implied usually less than 50%;
- typically will participate in specific science areas as part of Co-I led team

Dr. John Mattox	Boston U.	Dr. Annalisa Celotti	Int. School Adv. St.
Prof. Marc Kamionkowski	Caltech	Dr. Masanobu Ozaki	ISAS
Dr. Ann Wehrle		Dr. Tom Francke	KTH-Stockholm
Dr. F. Lebrun	CEA-Saclay	Dr. H. Mayer-Hasselwander	MPE
Dr. J. P. Dezalay	CESR Toulouse	Dr. Gottfried Kanbach	
Prof. Rene A. Ong	U. Chicago	Dr. Andrew Strong	
Prof. Mark Oreglia		Dr. Jeffrey D. Scargle	NASA Ames
Prof. G. Pelletier	U. Grenoble	Dr. Charles D. Dermer	NRL
Dr. J. T. Bonnell	GSFC	Prof. Vahe Petrosian	Stanford U.
Dr. Alice K. Harding		Prof. Roger Romani	
Dr. Stanley D. Hunter		Dr. E. do Couto e Silva	SU-SLAC
Dr. Floyd W. Stecker		Dr. Paul Kunz	
Dr. Matthew G. Baring	GSFC/USRA	Prof. Lars Bergstrom	Stockholm U.
Dr. Katsuichi Yoshida	Hiroshima U.	Dr. Yasushi Fukazawa	U. Tokyo
Prof. Ryoji Enomoto	ICRR, U. Tokyo	Prof. Joel R. Primack	UCSC
Prof. Masaki Mori		Prof. Stanford E. Woosley	
Dr. Piergiorgio Picozza	INFN	Prof. Brenda Dingus	U. Wisconsin

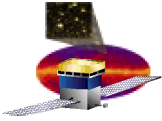


Senior Scientist Advisory Committee

advisory to Principal Investigator on scientific matters and will assist/advise in the scientific organization of the collaboration.

Guido Barbiellini
Elliott Bloom
Thompson Burnett
Per Carlson
Richard Dubois
Patrick Fleury
Neil Gehrels, chair
Isabelle Grenier
W. Neil Johnson

Robert Johnson
Tuneyoshi Kamae
Jonathan Ormes
Steve Ritz
Hartmut Sadrozinski
David Thompson
Roger Williamson
Kent Wood



GLAST Science Working Group (SWG) Members from LAT Team

- AO specified that Instrument PI plus up to 6 Co-Investigators (3 supported by NASA plus 3 additional Co-I's that are leads of foreign collaborating teams) can be designated members of SWG

Guido Barbiellini

Elliott Bloom

Isabelle Grenier

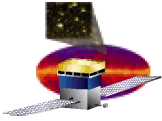
Peter Michelson

Tuneyoshi Kamae

W. Neil Johnson

David Thompson

Other members of the SWG, appointed by NASA, are the Project Scientist (Chair of SWG), 4 Interdisciplinary Scientists (IDS), and Secondary Instrument PI. (IDS: Charles Dermer, Brenda Dingus, Martin Pohl, Steve Thorsett,)




Issues

- Several issues face us regarding how we are organized scientifically. Some of these are:
 - Publication policy
 - Graduate student thesis topics
 - Etc.
- Publication Policy must acknowledge contributions of collaborators to instrument, to infrastructure required to support data analysis, and should encourage contribution of original scientific ideas
 - A possible approach: initial publications relatively inclusive (i.e., long author lists), transitioning to shorter author lists as analysis becomes more in-depth on particular topics; will ask SSAC to consider publication policy;
 - Must find means to insure that younger scientists (graduate students and postdocs) have opportunity to demonstrate scientific independence;
 - To assist PI and SSAC in organizing scientific analysis effort, ask each Co-I and Associate Scientist to prepare a brief (2 page) “mini-proposal” or statement of his/her primary scientific interest(s) and proposed approach, schedule, etc..

We've only got a few
years left before we
have to launch; let's
get to work



A photograph of a large colony of penguins on a sandy beach. In the foreground, a penguin on the left has a speech bubble above it. In the center, a penguin is lying down with a thought bubble above it. The background shows more penguins and a dark, hilly coastline under a cloudy sky.

We've only got a few years left before we have to launch; let's get to work

Slave Driver!